PRODUCTION ENGINEERING LABORATORY — SECTION 1

Casing and Cementing Accessories

Restoration, Function, and Field Reference

Restored tools — Production Engineering Laboratory, DUIET

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Table of Contents

Table of Contents 2
1. Introduction 3
2. Casing 3
2.1 Types of Casing (by Function in the Well) 3
2.2 Casing Grades 3
2.3 Casing Threads and Connections 4
2.4 Restored Specimen — Stencilled Markings 5
2.5 Video & Reference — Scan to Access 5
3. Casing Scraper 6
3.1 Why It Matters 6
3.2 Working Principle 6
3.3 Restored Tool — Photograph & Schematic 6
3.4 Video & Reference — Scan to Access 7
4. Float Shoe (Guide Shoe) 8
4.1 Working Principle 8
4.2 Restored Tool — Photograph & Schematic 8
4.3 Video & Reference — Scan to Access 9
5. Float Collar 10
5.1 Float Valve Inside the Float Collar 10
5.2 Why the Space Between Shoe and Collar Matters 10
5.3 Restored Tool — Photographs & Schematic 10
5.4 Video & Reference — Scan to Access 11
6. Centralizer 12
6.1 Why Centralisation Matters 12
6.2 Working Principle 12
6.3 Types Observed in the Laboratory 12
6.4 Restored Tool — Photograph & Schematic 12
6.5 Video & Reference — Scan to Access 13
7. Summary Table 13

1. Introduction

This document covers casing itself, along with the cementing and casing accessories restored as part of the Production Engineering Laboratory development exercise. These tools and tubulars together make up the casing string run during well construction and are essential to achieving a properly cemented, mechanically sound, pressure-isolated wellbore. Each entry below includes a description of function and working principle, the restored laboratory photograph, a labelled schematic, and QR codes linking to a video demonstration and a written reference for further study.

2. Casing

Casing is the large-diameter steel pipe run into the wellbore in successive strings of decreasing diameter as drilling proceeds to total depth. It is cemented in place and remains in the well for its entire life, providing structural support to the borehole wall, isolating different pressure zones and fluid-bearing formations from one another, protecting freshwater aquifers from contamination, and providing a confined, known-diameter conduit within which all subsequent drilling, completion, and production activity takes place.

2.1 Types of Casing (by Function in the Well)

- Conductor Casing — the first and shortest string, run to a shallow depth (commonly around 20 m onshore) to support unconsolidated near-surface formations and to carry returns to the shale shakers while drilling the surface hole.
- Surface Casing — run somewhat deeper (typically a few hundred to ~1,000 m) to protect freshwater aquifers from contamination and to provide a solid foundation for the blowout preventer (BOP) stack and wellhead.
- Intermediate Casing — the longest string in many wells, run to isolate troublesome formations encountered while drilling deeper — lost-circulation zones, abnormally pressured zones, unstable shales, or salt sections — so drilling can safely continue toward the reservoir.
- Production Casing — the final, deepest string, set across or just above the producing interval. It is the long-term barrier that supports the completion string and isolates the reservoir for production.
- Liner — an alternative to a full production (or intermediate) string that does not extend back to surface; instead it is hung from inside the previous casing string using a liner hanger, overlapping it by a short interval. Liners save on steel and cost compared to running a full string back to surface, at the expense of slightly more complex well control during installation.

2.2 Casing Grades

Casing is manufactured to API Specification 5CT, which defines steel grades primarily by their minimum yield strength. The grade designation uses a letter (largely historical, not tied to a strict

property scale) followed by a number indicating minimum yield strength in thousand pounds per square inch (ksi).

Grade	Min. Yield (ksi)	Typical Use	Notes
H-40	40	Shallow, low-pressure wells	Lowest common grade
J-55 / K-55	55	Shallow–moderate wells	K55 has higher tensile than J55
N-80	80	Moderate depth/pressure	Type 1 (normalized) or Q (quenched & tempered)
L-80	80 (restricted)	Sour (H_2S) service	Restricted yield range; 9Cr/13Cr variants for CO_2
P-110	110	Deep, high-pressure wells	High strength; example grade of laboratory specimen
Q-125	125	Extreme high-pressure wells	Highest common API casing grade

Grade selection is driven by well depth, anticipated burst, collapse, and tension loads, and whether the well environment is sour (H_2S-bearing), which calls for restricted-yield, sulfide-stress-cracking-resistant grades such as L-80 rather than higher but more brittle grades like P-110 or Q-125.

2.3 Casing Threads and Connections

Lengths of casing are joined end to end using threaded connections, defined under API Specification 5B. The three standard API connection types are:

- STC (Short Thread and Coupling) — 8 threads-per-inch round thread, 3/4 in/ft taper, shorter thread engagement. Used where loads are relatively low, such as conductor and some surface casing.
- LTC (Long Thread and Coupling) — the same round thread profile as STC but with a longer threaded engagement, giving meaningfully higher tensile strength and better seal integrity. LTC is the common standard for production and intermediate strings in moderate-depth wells, though it is not made above 13-3/8" due to pull-out risk in heavier-weight casing.
- BTC (Buttress Thread and Coupling) — a fundamentally different, flat-crested square-form (trapezoidal) thread at 5 threads-per-inch, giving higher joint and bending strength than LTC or STC. BTC is preferred for deeper wells with higher hook loads — the restored laboratory specimen below is stencilled as a buttress-thread ("BUTT THD") casing joint.

Beyond the three standard API connections, many operators specify proprietary "premium" connections for demanding service (high pressure, gas-tight, or extreme dogleg severity), which provide metal-to-metal seals beyond what thread compound alone can achieve in standard API connections.

2.4 Restored Specimen — Stencilled Markings

The casing joint restored in the laboratory carries clear factory stencilling, reproduced below as visible on the pipe body:

- Type 706
- 7" O.D., Butt(ress) Thread
- To be run on 29 m (joint length designation)
- Grade P-110 Casing

2.5 Video & Reference — Scan to Access

Scan: Video

Scan: Reference

Video: search — casing types, grades and threads explained (YouTube)

Reference: API 5CT Casing Grades — Overview (Sovonex)

3. Casing Scraper

A casing scraper is run on the workstring or casing string to mechanically remove mudcake, cement sheath remnants, rust, scale, and other deposits from the inner wall of the casing. It typically consists of a central body fitted with spring-loaded steel blades that ride against the casing ID, covering a full 360° as the tool is rotated and/or reciprocated through the section being cleaned.

3.1 Why It Matters

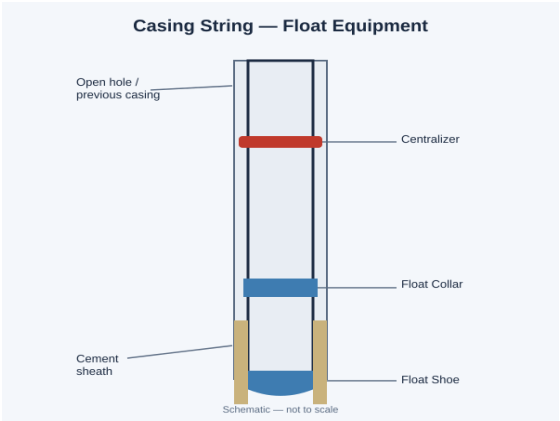
- A clean casing ID is essential for a good cement bond during squeeze or remedial cementing.
- Packers, bridge plugs, and other close-tolerance completion tools require a clean, smooth bore to set and seal correctly.
- Removing scale and burrs reduces the risk of damaging wireline or workstring tools run in afterward.

3.2 Working Principle

The scraper body carries two or more rows of spring-loaded blade blocks. As the tool is run in and rotated, the blades are pressed outward by their springs to maintain continuous contact with the casing wall, scraping loose any bonded material. Reciprocating the tool (moving it up and down) while rotating gives the most thorough cleaning, since the blades contact the full circumference from multiple angles during each pass.

3.3 Restored Tool — Photograph & Schematic

Casing Scraper, restored — Production Engineering Laboratory, DUIET



Position within casing string (schematic)

3.4 Video & Reference — Scan to Access

Scan: Video

Scan: Reference

Video: Casing Scraper for Well Drilling (YouTube)

Reference: How Does a Casing Scraper Work? (Vigor Drilling)

4. Float Shoe (Guide Shoe)

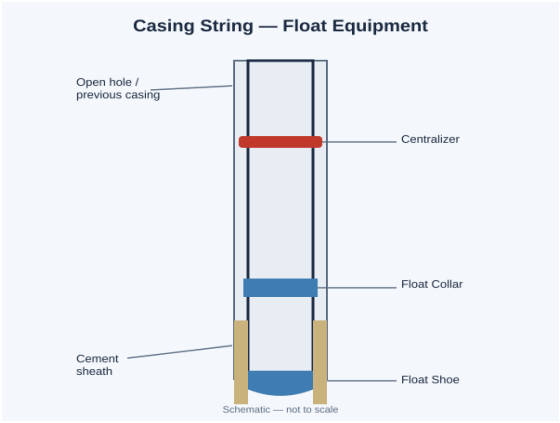
The float shoe is made up at the very bottom of the casing string. Its rounded, domed nose guides the casing past doglegs and ledges in the open hole as it is run in, and its internal back-pressure valve prevents wellbore fluids and cement from re-entering the casing once cement has been placed, while still allowing circulation on the way into the hole.

4.1 Working Principle

The restored specimen shows the rounded guide nose and the side ports through which drilling fluid and, later, cement slurry are circulated. The internal float valve (visible in the float collar specimen, Section 5) closes under reverse flow, sealing the shoe and preventing U-tubing of cement back into the casing after displacement.

4.2 Restored Tool — Photograph & Schematic

Float Shoe (Guide Shoe), restored — Production Engineering Laboratory, DUIET



Float shoe position — bottom of casing string

A second, full standing view of the restored float shoe is shown below, showing the complete body length, side ports, and domed nose alongside a centralizer for scale.

Float Shoe, full standing view — Production Engineering Laboratory, DUIET

4.3 Video & Reference — Scan to Access

Scan: Video

Scan: Reference

Video: Float shoe / float collar cementing animation search (YouTube)

Reference: Float Shoe and Float Collar in Drilling Operations (Drilling Manual)

5. Float Collar

The float collar is run one to three joints above the float shoe. It performs a similar check-valve function to the shoe and additionally provides the landing seat for the cementing wiper plugs. As the bottom plug lands on the float collar, a pressure spike at surface confirms the plug has seated; the top plug then follows behind the cement slurry and also lands on the collar once displacement is complete, giving a positive surface indication that cementing is finished and preventing over-displacement.

5.1 Float Valve Inside the Float Collar

Looking down into the bore of the restored float collar, the internal float valve is clearly visible — a flapper/poppet-style check element seated centrally in the bore. This valve is the working component that gives the float collar its one-way flow behaviour.

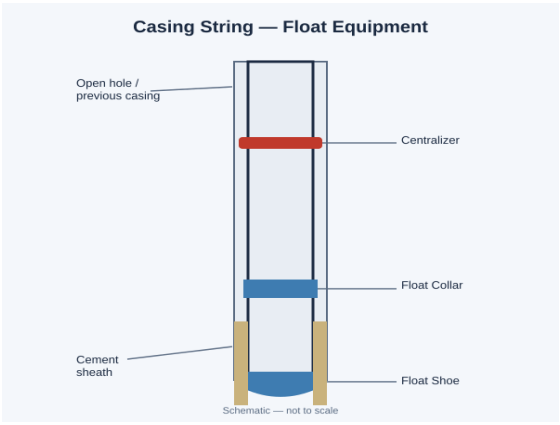
5.2 Why the Space Between Shoe and Collar Matters

The interval between the float shoe and float collar acts as a containment zone: it traps the leading, potentially contaminated cement (mixed with mud during the wiping action of the plugs) away from the shoe, where a strong, uncontaminated cement bond matters most for zonal isolation.

5.3 Restored Tool — Photographs & Schematic

The restored float collar is shown below as a standing body shot, alongside a close-up looking down into its bore where the internal float valve is clearly visible.

Float Collar, restored — Production Engineering Laboratory, DUIET



Float collar position — 1–3 joints above shoe

Float valve visible inside the float collar bore — the check element that prevents backflow

5.4 Video & Reference — Scan to Access

Scan: Video

Scan: Reference

Video: Float shoe / float collar cementing animation search (YouTube)

Reference: Float Shoe and Float Collar in Drilling Operations (Drilling Manual)

6. Centralizer

A centralizer is a spring-bow device clamped onto the casing exterior at calculated intervals along the string. Its purpose is to keep the casing centred within the open hole or within the previous casing string as it is run to total depth.

6.1 Why Centralisation Matters

- A centred casing allows cement to form a uniform, continuous sheath of even thickness all the way around the annulus.
- An off-centre (eccentric) casing leads to a thin cement layer on the narrow side, which is prone to channeling and poor zonal isolation.
- Poor zonal isolation can allow unwanted fluid migration behind casing, compromising well integrity and potentially requiring expensive remedial cementing.

6.2 Working Principle

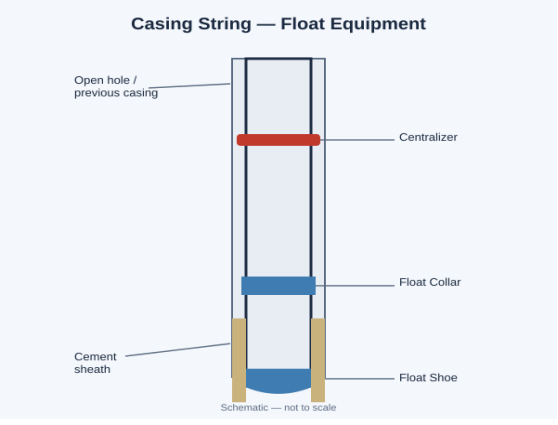
Bow-spring centralizers, as restored here, consist of curved steel bow springs riveted between two collar rings. As the centralizer passes through a restriction (a tighter section of hole or previous casing), the bows flex inward, then spring back outward once clear, maintaining continuous centring contact against the borehole or casing wall under their own spring force.

6.3 Types Observed in the Laboratory

The restored inventory includes bow-spring centralizers in red, blue, and black — the colour denotes different size/rating classes from different manufacturers or batches, following standard oilfield colour-coding practice so crews can visually confirm the correct centralizer is being run for a given casing size.

6.4 Restored Tool — Photograph & Schematic

Centralizers (red, blue, black), restored — Production Engineering Laboratory, DUIET



Centralizer position on casing string

6.5 Video & Reference — Scan to Access

Scan: Video

Scan: Reference

Video: Casing centralizer cementing animation search (YouTube)

Reference: Float Collar — an overview (ScienceDirect Topics)

7. Summary Table

Item	Primary Function	Run Position
Casing	Structural wellbore liner, pressure/zonal isolation	Full string, surface to TD
Casing Scraper	Removes mudcake, cement, scale, and debris from casing ID	Run on workstring as needed
Float Shoe	Guides casing in; one-way valve stops backflow	Bottom of casing string
Float Collar	One-way valve + cementing plug landing seat	1–3 joints above shoe
Centralizer	Keeps casing centred for uniform cement sheath	Spaced along casing string

This concludes Section 1 of the Production Engineering Laboratory tool reference series. See the companion files for Lifting & Floor Accessories, Downhole Drilling Equipment, Surface Production Tools, Subsurface Production Tools, and Fishing & Other Accessories.